

REMARKS

Claims 1-3, 14-17, 21 Meet Requirements of § 112.

Claims 1-3 and 14-17, and newly added claim 21, meet the requirements of Section 112. In sections 1 and 2 of the Official Action, claims 1-3 and 14-17 were rejected under Section 112, first paragraph, because (1) the specification does not describe a process that the application of the claimed temperature range results in a fullerene monolayer, and (2) that the step of applying a solvent or a beam is "critical" to the enablement of the process. Reconsideration is requested.

The Examiner is correct that the claimed temperature range does not, in and of itself, result in a fullerene monolayer. Irrespective that the claimed temperature range does not, of itself, cause the desorption of fullerene, Applicant has discovered that a fullerene monolayer can be achieved without the higher temperatures, thereby permitting formation of a monolayer of fullerene as a coating on articles that cannot sustain such high temperature. Specification, page 9, line 27 to page 10, line 18. Applicant's specification describes a process of obtaining a fullerene monolayer on articles without subjecting them to high temperatures previously required to break the fullerene-to-fullerene bond.

The Examiner further states that the application of a beam or solvent to the fullerene multilayer is a critical step to the process. The essence of the Examiner's rejection is that of breadth of the claims for not stating the beam or solvent step. Applicant describes two alternative techniques for breaking the fullerene-to-fullerene bond, a beam (several are disclosed) or a solvent (several are presented in a Markush group). These are alternative techniques and are not necessarily used together. Thus, the beam is not necessary where the solvent is used, and the solvent is not necessary where the beam is used. Applicant has presented two techniques of "removing layers of the fullerene

molecules while maintaining a temperature ... no more than 200°C [to achieve] an approximate monolayer of fullerene molecules" as recited in claim 1. It is respectfully submitted, that the claims are supported and enabled by the specification, and that the rejection under Section 112 should be withdrawn.

Claim 21, dependent on claim 1, is a Markush claim that recites that the layers are removed by a beam or solvent.

Claims 1-3, 14-17, 21 Are Patentable Under § 103.

Claims 1-3 and 14-17 have further been rejected under Section 103 as unpatentable over Hamza et al, alone or in view of Bethane. In part, this rejection is also based on the Section 112 rejection described above. More particularly, the Examiner states the claims are written as if low substrate temperature is all that is needed to desorb the fullerene multilayers. The Examiner's view is that these claims are directed to an inoperative process (presumably a Section 101 rejection) if the lower temperature range does not cause the desorption. It is respectfully submitted that the issue is not whether the lower temperature will cause the desorption (which it alone does not), but instead is whether the desorption can be achieved at the lower temperatures (which it can).

Hamza teaches desorption of fullerene molecules at or above desorption temperatures (225 to 300°C). Hamza does not make it obvious to one of ordinary skill in the art to somehow modify the Hamza teachings to desorb fullerene molecules on temperature sensitive substrates without subjecting the substrate to the high desorption temperatures. Hamza does not make obvious desorption of fullerene molecules at temperatures below known desorption temperatures, as recited in Applicant's claims. Indeed, nothing in Hamza suggests desorption of fullerene molecules by any other technique than subjecting the substrate to high desorption temperatures.

It is submitted that Bethane does not overcome the deficiencies of Hamza. Bethane teaches two techniques of deposition (not desorption): One, a sublimation process, subjects the substrate to higher temperatures (above about 550°C). Col. 4, line 36-38. The other is a sputter deposition technique in which a toluene solution of fullerene is applied to a magnetic disk by a spin coat technique to achieve a seed layer of about one-third monolayer of fullerene. Fullerene is then sputter deposited to a thickness of about 100Å. Thus, Bethane does not achieve an approximate monolayer as claimed. Moreover, it would not be obvious to somehow combine the teachings of Hamza and Bethane to remove layers of fullerene leaving an approximate monolayer of fullerene molecules without exceeding about 200°C, as recited in claim 1. Nor would it be obvious to remove the layers using a beam or solvent as recited in claim 21. Therefore, claims 1-3, 14-17 and 21 are patentable over the references.

Claims 4-13 and 22-27 are Clearly Allowable.

The subject matter of claims 4-13 was found allowable. By the present amendment, claim 4 is independent, dependent claims have been conformed, and dependent claims 22-27 have been added paralleling claims 2, 3 and 14-17 but dependent on claim 4. Therefore, claims 4-13 and 22-27 are clearly in condition for allowance.

Claims 18-20, 28-32 Are Patentable Over the References.

Claims 18 and 19 were rejected as unpatentable over the IBM Bulletin and claim 20 was rejected as unpatentable over the IBM Bulletin in view of Bunshah. The Examiner's interpretation of the IBM Bulletin is that after the fullerene molecules are displaced from the substrate by the STM or FM tip, the displaced fullerene molecules are solvated by the solution (and presumably carried away when the solution is washed off). In support of this interpretation, the Examiner states that the STM or FM tip

does not cause the fullerene molecules to double up (into multilayers).

It is respectfully submitted that the Examiner's interpretation of the IBM reference is in error. It is submitted that the displaced fullerene molecules do double up (form multilayers) after displacement by the STM of FM tip, it's just that they are not shown in Figs. 5 and 6. More particularly, Figs. 2 and 3 show multilayers of fullerene molecules. As shown in Fig. 4, these multilayers are still present when the solution is added, and the solution is not shown as containing fullerene molecules. Moreover, the only stated function of the solution is as a carrier for the self-assembling molecules 5, not as a solvent for the fullerene-to-fullerene bond. Thus, when tip 3 pushes away fullerene molecules from the substrate, the self-assembling molecules bond to the substrate in the place of the now-missing fullerene molecule.

Where do the displaced fullerene molecules go? While the IBM Bulletin does not state what happens to the displaced fullerene molecules, three facts are evident from the IBM Bulletin: First, the displaced molecules are not shown in the solution of Figs. 4 or 5. Second, the displaced molecules are not shown bonded to the self-assembling molecules. Third, the only stated function of the solution is as a carrier for the self-assembling molecules 5. From this, it is apparent that the self-absorbing molecules prevent a bond between the displaced fullerene molecules and the substrate. Therefore the displaced fullerene molecules do not bond well to the self-assembling molecules. Thus, the displaced fullerene molecules of the IBM Bulletin must bond to other fullerene molecules to form a multilayer, distal from the location of the self-absorbing molecules. If that is the case, the IBM Bulletin does not describe a solvent that "break[s] the fullerene-to-fullerene intermolecular bond" as recited in claim 18. An interpretation

that the displaced molecules solvate into the solution or are carried away when the solution is washed off is contrary to the depiction of Figs. 4 and 5.

Moreover, even if the displaced fullerene molecules were solvated into the solution and carried away when the solution is washed off, there is nothing in the IBM Bulletin to suggest that fullerene-to-fullerene bonds in a multilayer of fullerene molecules are "broken" by the solution to form a monolayer as recited in claim 18. Instead, the only disclosure of breaking bonds is by the STM or FM tip.

Moreover, claim 18 states that the process of forming the coating consists essentially of forming the multilayer, applying a solvent, and removing the solvent. The use of the exclusionary "consisting essentially" excludes additional essential steps to the process. Since the IBM Bulletin requires use of the STM or FM tip as an essential part of the process, claim 18 excludes that step.

For the above reasons, claims 18 and 19 are patentable, under § 103, over the IBM reference.

Claim 20 is also patentable over the IBM reference for the same reasons. Additionally, Bunshah is concerned with the production of fullerene-60 or -70, not with its deposition. The toluene solvent used by Bunshah is simply a convenient recovery solution for the fullerene and is not used to break fullerene-to-fullerene bonds in a multilayer of fullerene molecules.

Claims 28-32 are based on former claims 3 and 14-17, but are dependent on claim 18. It is therefore submitted that claims 13-20 and 28-32 are in condition for allowance.

Therefore, for the reasons given in the Response filed December 9, 2002, the rejection of these claims should be withdrawn.

The Director is authorized to charge any fee deficiency required by this paper or credit any overpayment to Deposit Account No. 23-1123.

Respectfully submitted,

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MARKED-UP VERSION OF REPLACEMENT CLAIMS

Claims 1-3 are unchanged.

4. (Twice Amended) A process of forming a coating on a substrate, the process comprising steps of:

a) forming a coating on the substrate comprising a plurality of layers of fullerene molecules;

b) ~~The process of claim 1, wherein step (b) includes:~~

~~—e1)—~~adjusting a beam generator to produce a beam arranged to break the fullerene-to-fullerene intermolecular bond of the coating and inadequate to break the fullerene-to-substrate association/bond of the coating; and

~~e2c)~~ directing the beam at the coating to break the fullerene-to-fullerene intermolecular bond while maintaining a temperature of the substrate at no more than about 200 degrees C, leaving an approximate monolayer coating of fullerene molecules on the substrate.

Claims 5-9 are unchanged.

10. (Twice Amended) The process of claim 4, wherein step ~~(e2c)~~ includes:

directing the beam at an acute angle to the substrate.

Claim 11 is unchanged.

12. (Twice Amended) The process of claim 4, wherein step ~~(e2c)~~ further includes steps of:

i) focusing the beam so that the beam impinges less than all of the coating, and

- ii) moving the beam generator relative to the substrate so that the beam successively impinges substantially the entire coating.

13. (Twice Amended) The process of claim 4, wherein step ~~(b)~~c) includes

- i) focusing the beam so that the beam impinges less than all of the coating, and
- ii) moving the beam generator relative to the substrate so that the beam successively impinges selected portions of the coating.

Claims 14-17 are unchanged.

18. (Twice Amended) A process of forming a coating on a substrate, the process consisting essentially of the steps of:

- a) forming a coating on the substrate comprising a plurality of layers of fullerene molecules;~~The process of claim 1, wherein step (b) includes steps of:~~

- b) applying a solvent to the coating at no more than about 100 degrees C for a period of time adequate to break the fullerene-to-fullerene intermolecular bond of the coating and inadequate to break the fullerene-to-substrate association/bond of the coating to thereby remove the fullerene molecules from the coating that are not bonded to the substrate;; and

- c) removing the solvent leaving an approximate monolayer coating of fullerene molecules on the substrate.

Claims 19 and 20 are unchanged.